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THREE NEW MAMMALS FROM SALT MARSH AREAS
IN SOUTHERN CALIFORNIA.

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Investigations recently carried on by Mr. George G. Cantwell and the writer in the salt marsh at Playa del Rey, Los Angeles County, California, have revealed the existence of three previously unnamed races of mammals, a shrew, a harvest mouse and a meadow mouse, herewith described. In order to gain further knowledge of the distribution of these new forms, the writer visited the salt marshes at Anaheim Bay, Orange County, and Point Mugu, Ventura County, during May, 1932.

For the loan of comparative material, the writer wishes to express his thanks to Dr. Joseph Grinnell and Mr. Seth B. Benson, of the Museum of Vertebrate Zoology, Berkeley, California, to Dr. Wm. H. Burt, of the California Institute of Technology, Pasadena, California, to Mr. Bernard Bailey, of Escondido, California, and to Mr. Kenneth E. Stager, of Los Angeles, California. To Messrs. George Willett and George G. Cantwell, of the Los Angeles Museum, Los Angeles, California, the writer wishes to express his appreciation of the many helpful suggestions and criticisms received from them, whereby, it is hoped, errors in this paper may be reduced to a minimum. Color terms used in the following descriptions are from Ridgway's *Color Standards and Color Nomenclature*, 1912.

Sorex ornatus salicornicus, subsp. nov.

SOUTHERN MARSH SHREW.

Type.—Male adult, skin and skull, no. 1680, collection of Jack C. von Bloeker, Jr., from Playa del Rey, Los Angeles County, California, collected by Jack C. von Bloeker, Jr., March 13, 1932.

Distribution.—In so far as is known, coastal marshes in Los Angeles and

Ventura counties, California; from Nigger Slough, Los Angeles County, to Point Mugu, Ventura County.

Diagnosis.—A small, dark-colored shrew of the *ornatus* group, with the belly hairs slate color basally and tipped with pale smoke gray; tail bicolor, bone brown above and on ventral tip, remaining ventral portion drab gray; skull short, and small throughout.

Comparisons.—Compared with *Sorex ornatus ornatus*, averages smaller in body size; tail shorter; color of dorsal and ventral pelage averages much darker. Skull actually and relatively smaller throughout, with more flattened brain-case. Compared with *Sorex ornatus californicus*, about equal in external measurements, color averages slightly darker. Skull actually and relatively smaller. Compared with *Sorex ornatus relictus*, equal in external measurements, color averages slightly lighter. Skull actually and relatively shorter and narrower, with much lower brain-case. Compared with *Sorex sinuosus*, smaller throughout and lighter colored.

Color.—Type (in winter pelage): Dorsal hairs with terminal portions black, subterminal bands olive brown, basal portions blackish slate. Ventral hairs slate color basally and tipped with smoke gray. Tail with dorsal surface and ventral tip bone brown, rest of ventral surface of tail and upper surface of feet drab gray. Hairs at base of vibrissae and on nose black.

In summer pelage the dorsal hairs are colored with bister subterminally and the ventral hairs are tipped with drab gray.

Measurements (in millimeters).—Average of ten adults (5 males and 5 females), including the type: Total length, 96.2 (85.0–102.0); tail, 36.45 (29.5–42.0); head and body, 59.75 (50.0–64.0); hind foot, 11.55 (10.5–12.0); ear, from crown, 4.0 (3.0–5.0). Skull: Condylbasal length, 15.71 (15.4–16.0); palatal length, 6.12 (5.9–6.4); cranial breadth, 7.65 (7.4–7.9); greatest height of cranium, 4.37 (4.2–4.6); interorbital breadth, 3.26 (3.1–3.4); maxillary breadth, 4.53 (4.5–4.6); maxillary tooth row, 5.71 (5.5–5.9).

Specimens examined.—Specimens, unless otherwise indicated, are in the writer's collection. Total number examined, thirty-nine, all from California, as follows:

Sorex ornatus ornatus, 12; KERN COUNTY; San Emigdio Creek (type locality), 2;¹ Mount Pinos, 1;¹ Fort Tejon, 1;¹ Bakersfield (approaching *relictus*), 2;¹ Piute Mountains, 2;² INYO COUNTY; Little Lake, 1;¹ FRESNO COUNTY; Minkler, 2;¹ MARIPOSA COUNTY; Dudley, 1.¹

Sorex ornatus californicus, 10; CONTRA COSTA COUNTY; Walnut Creek (type locality), 1;¹ ALAMEDA COUNTY; Berkeley, 6;¹ Haywards, 3.¹

Sorex ornatus relictus, 2; KERN COUNTY; Buena Vista Lake (type locality), 2.¹

Sorex ornatus salicornicus, 10; LOS ANGELES COUNTY; Playa del Rey (type locality), 8;³ Nigger Slough, 1; VENTURA COUNTY; Point Mugu, 1.²

Sorex sinuosus, 5; SOLANO COUNTY; Grizzly Island (type locality), 5.¹

¹Museum of Vertebrate Zoology.

²Los Angeles Museum.

³Two in Los Angeles Museum, one in collection of Donald R. Diekey.

Remarks.—Systematically the race *S. o. salicornicus* occupies a position intermediate in color and external characters between *S. o. californicus* and *S. o. relictus*, retaining, in majority, skull characters of smaller dimensions than any previously named form of the *Sorex ornatus* group.

***Reithrodontomys megalotis limicola*, subsp. nov.**

SOUTHERN MARSH HARVEST MOUSE.

Type.—Female adult, skin and skull, no. 2991, Los Angeles Museum, from Playa del Rey, Los Angeles County, California, collected by George G. Cantwell, January 30, 1932.

Distribution.—In so far as is known, coastal marshes in Orange, Los Angeles, and Ventura counties, California; from Anaheim Bay, Orange County, to Point Mugu, Ventura County.

Diagnosis.—A medium-sized, dark-colored harvest mouse of the *megalotis* group, with the belly hairs slate color basally with short white tips, giving the underparts a bluish gray cast; tail distinctly bicolor, black above and white below; skull short and narrow, with slender rostrum and small mastoid bullae.

Comparisons.—Compared with *Reithrodontomys megalotis longicauda*, about equal in total length, head and body length relatively shorter, and tail relatively longer; color averages darker dorsally, grayish tinge not being as prominent. Skull actually and relatively smaller throughout; zygomas not as sharply curved downwards.

Color.—Type: Dorsal hairs with terminal portions black, narrow sub-terminal bands pale yellow orange, basal portions plumbeous black. Hairs of underparts blackish plumbeous basally and tipped with white. A small spot of pale yellow orange tipped hairs is present on the chest. Upper surface of feet and lower surface of tail very thinly covered with entirely white hairs; hairs on dorsal surface of tail black. A spot of black hairs is present on each side at base of vibrissae.

Measurements.—Average of eight adults (3 males and 5 females), including the type and seven paratypes: Total length, 142.0 (134.0–148.0); tail, 78.0 (70.0–88.0); head and body, 64.0 (60.0–66.0); hind foot, 17.0 (16.0–18.0); ear, from crown, 13.5 (13.0–14.0). Skull: Occipito-nasal length, 20.2 (19.8–20.5); width of cranium, 9.86 (9.5–10.0); zygomatic width, at center of zygomas, 9.55 (9.3–9.8); least interorbital breadth, 3.17 (3.0–3.4); upper molar series, 2.98 (2.9–3.1).

Specimens examined.—Total number examined, two hundred and two, all from California, as follows:

Reithrodontomys raviventris raviventris, 40; SAN MATEO COUNTY; Redwood City (type locality), "salt marsh," 4;⁴ SANTA CLARA COUNTY; Palo Alto, 4;⁴ ALAMEDA COUNTY; Melrose Marsh, 32.⁵

Reithrodontomys raviventris halicoetes, 22; SONOMA COUNTY; Petaluma (type locality), "salt marsh," 16;⁴ SOLANO COUNTY; Cordelia, 6.⁴

Reithrodontomys megalotis longicauda, 63; SONOMA COUNTY; Petaluma

⁴Museum of Vertebrate Zoology.

⁵Thirteen in Museum of Vertebrate Zoology.

(type locality), "foothills," 2;⁴ ALAMEDA COUNTY; Oakland, 1; SAN MATEO COUNTY; Redwood City, "foothills," 9;⁴ SOLANO COUNTY; Vacaville, 3 miles west, 8;⁴ Rumsey, 6;⁴ SANTA CLARA COUNTY; Black Mountain, 1;⁴ Palo Alto, 3;⁴ MONTEREY COUNTY; Jolon, 1;⁶ Moss Landing, 2; Salinas, 3 miles west, 1;⁶ SANTA CRUZ COUNTY; Granite Creek, 2; KERN COUNTY; Mount Pinos, 7;⁷ LOS ANGELES COUNTY; Sawtelle, 4;⁸ Arcadia, 1; Big Santa Anita Canyon, San Gabriel Mountains, 2; Alhambra, 1;⁶ San Antonio Canyon, San Gabriel Mountains, 2;⁶ Arroyo Seco, San Gabriel Mountains, 2;⁶ Rancho La Brea, 2;⁶ SAN DIEGO COUNTY; Alvarado Canyon, 1; Monument no. 258, United States-Mexico Boundary, 12.

Reithrodontomys megalotis limicola, 77; LOS ANGELES COUNTY; Playa del Rey (type locality), "salt marsh," 46;⁹ Gardena, Nigger Slough, 5; Hyperion, 2; ORANGE COUNTY; Anaheim Bay, 8;⁶ VENTURA COUNTY; Point Mugu, 16.⁶

Remarks.—In so far as is known, the race *R. m. limicola* is confined strictly to marshland areas; usually coastal salt marshes where *Salicornia* is present in abundance. An exception, of course, is the five specimens from the Gardena section of Nigger Slough, Los Angeles County, here referred to *limicola*. Previous to the draining of Nigger Slough there was an abundance of *Salicornia* present throughout the area, the water was more or less brackish, and the area was typically a "salt marsh."

***Microtus californicus stephensi*, subsp. nov.**

STEPHENS MEADOW MOUSE.

Type.—Female adult, skin and skull, no. 1519, Los Angeles Museum, from Playa del Rey, Los Angeles County, California, collected by George G. Cantwell, March 3, 1930.

Distribution.—In so far as is known, coastal marshes in Orange, Los Angeles, and Ventura counties, California; from Sunset Beach, Orange County, to Point Mugu, Ventura County.

Diagnosis.—A medium-sized, very dark-colored meadow mouse of the *californicus* group, with the ventral hairs blackish plumbeous basally and tipped with cinereous; tail distinctly bicolor, black above and cinereous below; skull long and narrow, with relatively narrow rostrum.

Comparisons.—Compared with *Microtus californicus californicus*, total length shorter, head and body length relatively longer, and tail actually and relatively shorter; hind foot larger; color averages much darker throughout. Skull, longer and narrower, upper molar series shorter. Compared with *Microtus californicus sanctidiegi*, smaller in external measurements and color averages much darker throughout. Skull averages longer and narrower, upper molar series shorter.

Color.—Type: Dorsal hairs with terminal portions black, narrow sub-terminal bands warm buff, basal portions plumbeous black. Ventral hairs

⁶Los Angeles Museum.

⁷Three in Los Angeles Museum.

⁸One in Los Angeles Museum.

⁹Sixteen in Los Angeles Museum.

blackish plumbeous basally and tipped with cinereous. Upper and lower lips lined with totally white hairs. A spot of totally white hairs is present in the region of the vent. Vibrissae blackish basally with long cinereous tips. Hairs of upper surface of tail black; hairs of lower surface of tail and upper surface of feet cinereous. The general effect in appearance of the dorsal coloration is black, with slight pepper-and-salt pattern.

There is considerable individual variation in darkness of dorsal coloration in *stephensi*; specimens showing a color range, in effect of, from brown to black have been examined. The type was selected as intermediate between the two extremes.

Measurements.—Average of ten adults (7 males and 3 females), including the type and nine paratypes: Total length, 170.4 (160.0–180.0); tail, 49.1 (44.0–60.0); head and body, 123.3 (117.0–128.0); hind foot, 22.1 (20.0–23.0); ear, from crown, 13.5 (13.0–14.0). Skull: Occipito-nasal length, 27.49 (26.9–28.1); height of cranium at bullae, 10.32 (10.0–10.6); mastoid width, 12.82 (12.4–13.3); zygomatic width, 16.07 (15.1–16.6); least interorbital breadth, 3.52 (3.3–3.7); upper molar series, 6.91 (6.6–7.2).

Specimens examined.—Total number examined, one hundred and seventy-seven, all from California, as follows:

Microtus californicus californicus, 24; SANTA CLARA COUNTY; Palo Alto (type locality), 6;¹⁰ ALAMEDA COUNTY; Piedmont, 6;¹⁰ Elmhurst, 1;¹⁰ Melrose Marsh (not typical), 10;¹¹ MONTEREY COUNTY; Moss Landing, 1.

Microtus californicus sanctidiegi, 41; SAN DIEGO COUNTY; Escondido (type locality), 9;¹² Chula Vista, 3;¹⁰ Cuyamaca Mountains, 4;¹⁰ Foster, 6 miles north, 6;¹⁰ Alvarado Canyon, 2; Point Loma, 2; Monument no. 258, United States-Mexico Boundary, 1; LOS ANGELES COUNTY; Sawtelle, 2; San Antonio Canyon, San Gabriel Mountains, 2;¹³ Camp Baldy, San Gabriel Mountains, 1;¹³ Bear Flat, San Gabriel Mountains, 1.¹³

Microtus californicus stephensi, 112; LOS ANGELES COUNTY; Playa del Rey (type locality), 46;¹⁴ ORANGE COUNTY; Sunset Beach, 2;¹⁵ Anaheim Bay, 37;¹³ VENTURA COUNTY; Point Mugu, 27.¹³

Remarks.—Geographically the race *M. c. stephensi* occupies the area along the coast between the ranges of *M. c. californicus* and *M. c. sanctidiegi*, being confined, in so far as is known, to salt marsh areas. It intergrades with the latter form as shown by specimens from Sunset Beach, Orange County, here referred to *stephensi* on the basis of skull characters.

This race is named in honor of Mr. Frank Stephens, of San Diego, California.

All of the races here named are characterized in common by dark coloration. Similarly specimens of *Peromyscus* and *Mus* from these salt marshes show this same tendency but, in the case of the former, insufficient material at hand and, in the case of the latter, lack of comparative material being

¹⁰Museum of Vertebrate Zoology.

¹¹Nine in Museum of Vertebrate Zoology.

¹²Two in Museum of Vertebrate Zoology, seven in collection of Bernard Bailey.

¹³Los Angeles Museum.

¹⁴Twenty-three in Los Angeles Museum.

¹⁵One in Los Angeles Museum, one in collection of Kenneth E. Stager.

available, restrains the writer from naming these forms. When the necessary material has been gathered together and differences compared, they, also, may merit racial recognition.

As pointed out by Dr. Joseph Grinnell (1913, p. 194), there seems to exist a direct relationship between salt marsh inhabitation and quantity of pigmentation. However, in apparent contradiction to this theory, it is also shown that the *blackest* forms known occur in areas where the marshes are least salt (loc. cit.), or, in the case of a recently described shrew (Grinnell, 1932), where *no* salt is in evidence! It is the present writer's belief that salt, in itself, is not the prime factor in this co-relationship between darkly colored, marsh dwelling forms and the areas in which they exist. Observations made in the several salt marshes from which specimens were taken for the present study reveal that, without exception, the soil in each marsh is of a decidedly black nature, caused by stagnation of decaying plant and animal life. Recently the writer visited the Melrose Marsh, in the San Francisco Bay region, making similar investigations which revealed the same soil characterization. It is known, to a certain extent, that coloration is affected by the nature and type of country in which a species or race may exist. Animals living in other types of country show direct relationship between the color and nature of the soil in which they live and the amount of pigmentation. For instance, in New Mexico certain lava field inhabiting mammals show great amount of pigmentation while those inhabiting white sand show lack of pigmentation. Is it not reasonable, therefore, to believe that, in a similar way, the color and nature of the soil in the marshes is truly the primary factor of the co-relationship between dark coloration and palustrine habit?

Laboratory experiments in tanning mammal hides with varying proportions of salt in the solutions show marked tendencies towards changing the coloration of brown or yellow hairs to reddish. The more salt added, the more pronounced the change. Is it not possible that salt in the marshes has a similar effect upon the coloration of the pelage? Most small mammals of restricted range, not distinctly marsh dwellers, show a large degree of brown coloration in the subterminal bands of the dorsal hairs. Near related forms living in salt marshes show an increased reddishness in this coloration. In the marshes around the south arm of San Francisco Bay, where the salt is in greatest proportion, are found the reddest forms. In the Suisun Bay area, where the marsh is least salt, are found the blackest forms wherein no reddish tendency exists. This is due, according to the present theory, to the lessening in degree of the amount of salt in the marsh. In the marshes under consideration in Southern California a half-way parallel in amount, or degree, of salt is presented, the mammals being intermediate in coloration between the two extremes in the marshes in west-central California.

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